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THE NEED OF MONOGRAPHIC ACTIVITY IN AMERICAN BOTANICAL TAXONOMY[1]

IT recently fell to my lot to oversee the reclassification of a large botanical library during its reshelving at the Gray Herbarium. Many questions arose during the process, most of them relating to clearness and expediency from the standpoints of library methods and experience. With these I will not trouble you. But incidentally I was impressed by certain quantitative aspects of botanical literature, particularly of taxonomic publication. These proved interesting to me and I hope I can make them so to you.

Nearly all publications on systematic botany fall pretty readily into one or the other of two chief categories: they are either floras, dealing with the vegetation of some particular region, or they are monographs treating a special group of plants. Our fundamental division was, therefore, into floras, arranged geographically, and monographs, classified systematically.

In this grouping the first thing that struck me was the overwhelming predominance, both in bulk and numbers, of the floristic works over the monographic. The second was that of the monographs, that is to say of those works treating not a region but a particular group of plants; the output in America has at all times been exceedingly small compared with that in Europe. Finally it was evident that most of the monographic work thus far accomplished in America has been restricted to purely American groups, exceedingly little of it taking on a cosmopolitan character.

The historic reasons for this state of affairs are tolerably obvious and there is no need to go into them at any length. American botany is relatively recent and its workers, at no time very numerous, have been confronted by the overwhelming task of reducing to systematic

[1] A communication read before the Systematic Section of the Botanical Society of America, December 29, 1922.

record the immensely diversified flora of a continent. Until lately the United States has not been a colony-holding power. Its scientific collections have not had that influx of material from remote quarters of the globe which has for many decades, indeed for two or three centuries, been pouring into the great herbaria and stimulating research in several of the Old World nations long holding remote colonial possessions.

Whatever may have been the causes the fact is one which we must face. Certainly more than ninety per cent., probably ninety-five or even ninety-eight per cent. of the cosmopolitan treatments of plant groups have been elaborated and published in Europe. In this form of botanical activity America has shown striking lack of ability or want of interest. She has never even tried to do her part. It is worth while to examine this particular form of aloofness. The pertinent questions are these: In how far is monographic activity really important? If it is of fundamental significance in our science, why are we so backward in regard to it? Is our nation active in proportion to its ability? Is it subject to some handicap precluding efficiency in this field? Is it unconsciously shirking an obligation? Is it missing an opportunity? Finally, what is the relation of such close and detailed study of plant groups to our national power, to our preparedness both in war and peace?

To answer such questions it is of the first importance to grasp the relations existing between floristic and monographic research. It must be understood that they are coordinate modes of investigation, of like dignity, difficulty, scope and importance. Each, however, has its peculiar advantages, each its specialized methods, each its allure, its psychological bias, each its practical importance in the ultimate scientific record of the world's vegetation. From a theoretical standpoint their material is of like extent as in qualitative and quantitative analysis. The task of the systematist will not be completed until each region has its flora and each natural group its monograph.

The materials for floristic work are everywhere ready to hand. Each region has its vegetation. Its plants attract by their diversity. The study of a local flora has great fascination. It appeals alike to amateur and professional. It is replete with opportunities for field work, personal collecting, exploration. It is in large measure an out-of-door job. Usually it is also a companionable enterprise involving cooperation, since few floras can be prepared by the single-handed exertion of any one investigator.

The monographer, on the other hand, must have access to large collections and libraries. Even then he must patiently assemble much of his material by correspondence. The plants of his group are likely to be scattered in remote quarters of the globe. He is rarely able to see them—at least most of them—in nature. He has to work with other people's specimens and make the most of collectors' notes. His task is chiefly an indoor one. It is apt to be a lonely one.

The published flora is a matter of popular interest. It has a sale. There are even calls for successive editions. It is true its author is rarely enriched by the proceeds, but he has the gratification of knowing his work useful. He sees that it meets with a measure of appreciation.

The monographer finds his wares much less in demand. He almost always has difficulty in securing a publisher. The sale is slight and very slow. In other features of his task, however, the monographer has advantages over the floristic writer. Floras usually have many hundreds, often thousands of species. If their treatment is to be completed in a lifetime there must be haste. If the result is to be brought within the limits of publication there must be compression. Elimination becomes necessary. Exceptions must be suppressed. Doubtful cases may not be discussed. Synonymy must be trimmed to its most important elements. Bibliography has to be cut to a minimum. Even descriptions must be brought down to telegraphic brevity. The final product becomes dogmatic.

The floristic writer, thus overwhelmed by the number of elements to be treated, is forced to relegate extra-limital species to temporary oblivion and neglect, except in so far as their hurried examination is necessary to establish the identity of plants within his range. Furthermore, the elements included commonly form only small and disjointed fragments of the natural groups they represent. This frequently lends them a specious distinctness which they

are far from possessing in nature. There is an almost unavoidable temptation to distort categorical values. Thus a variety in nature may in a given region appear to be a species. Still more frequently a subgenus or section tends to assume undue clarity and seems to merit the rank of a full-fledged genus.

It is in the monograph that nearly related plants are brought together no matter what their geographic remoteness may be. It is to the monographer that we must turn for well-judged estimates of the distinctness of groups and of their appropriate rank in classification.

In general the monographer is less closely tied down by the limits of time and space. His group usually contains fewer species. They can receive greater individual attention. Transitions and exceptions can be discussed. Descriptions can be drawn in far greater detail. Complete synonymy, copious bibliography, and the citation of exsiccatæ become features of importance. The monograph is rarely undertaken in the course of professional routine and surely never for personal gain. It is the kind of thing which must be done *con amore* and in a leisurely way—a charming puzzle which must often be laid aside only to be taken up again as opportunity permits. There is nothing that the monographer loathes so much as compilation. He must acquire not merely a bowing acquaintance but a real friendly familiarity with each element in his group. Many of his most important decisions come toward the end of his work, being doubtless brought about by cumulative observations and slowly trained judgment.

Let no one understand me to imply that work of this nature is not done in our country. There have been notable examples of it. Where may the world look at present for special knowledge of groups like the Laboulbeniaceæ, certain portions of the Orchidaceæ, and of genera like Yucca, Phoradendron, Nymphaea, Cuscuta, Lonicera, or certain parts of that exceedingly difficult family, the Cactaceæ? Many other groups also are now being studied in truly monographic spirit. The rusts, the hepatics, the mosses, the ferns, the grasses, Carex, Passiflora, the Scrophulariaceæ, the Lentibulariaceæ, certain portions of the Compositæ, for example. The work of most of the investigators here alluded to has undoubtedly begun from interest in the local North American elements in their respective groups. It is, however, apparently taking a broader turn as time goes on and we may hope for a finished monographic result.

Nevertheless, any such list of monographic undertakings in the United States is impressive not by reason of its length, but quite to the contrary. Its wide gaps are its striking feature. While one can well-nigh count upon his fingers the groups which are now being followed up in our country with any prospect that their treatment will take on a cosmopolitan scope, there are scores and hundreds of groups for which no North American specialist is yet in sight or even remotely in training.

Floristic and monographic work are reciprocal and interdependent. Both are essential to satisfactory progress in our subject. Floristic endeavor is certainly the pioneering enterprise. It is to secure knowledge of the general vegetation not of particular groups that practically all botanical exploration is initiated and collections are brought together. Thus until floristic work has made some headway monographic activity is impossible, but on the other hand floras can attain excellence only in proportion as they gradually assimilate the results of monographic investigation.

It is to the monographer that we must go for detailed elaboration and for highly trained judgment as to categorical values. To the floristic writer we look for things no less important, namely careful elimination, terse presentation, clear keys, and for the works that popularize our subject. Were there no other grounds than these it should be clear that our country ought to be doing its fair share of monographic as well as floristic work. But there is another point that I would emphasize. A good monograph can not be produced without creating *ipso facto* a specialist, a person of trained familiarity with a group, an authority to whom we may turn for precise and prompt information concerning it. Such specialists are national assets.

The practical importance of plant classification is little understood. Very few people realize the great number of plants which have come to have economic and industrial significance. Vegetable products are so important to humanity and their use for foods, fibers, medicines, timbers, dyes, condiments, flavors,

oils, waxes, gums, resins, and what not, has become so much a matter of course that it is apt to be taken for granted. I am told that in horticulture alone more than twenty-five thousand kinds of plants have been brought into use and thus acquired commercial value. Hundreds of others have gained significance in pharmacy and the industrial arts. But the most pertinent fact of all is that there are still thousands of plants which have never been investigated as to their possible utility—species either not yet collected at all or so imperfectly known that they could not at present be precisely identified by any systematist in our country.

Do we not clearly need specialists? Can we get them in any other way than by encouraging monographic attention to particular limited groups? We have long been dependent upon our European colleagues for nearly all monographic works of reference. Recent years have greatly altered conditions. The European output of this type of finished work of reference has already been diminished. It is clearly up to us to do our part, indeed for the next two or three decades if possible rather more than our normal share in this highly significant activity.

How is this work to be fostered? Gradually, of course. No abrupt change would be either feasible or desirable. Much may be accomplished if the need is clearly grasped. Let each botanical establishment, each botanical society, club and journal stress the importance of this type of published output and facilitate the initial efforts of all students, whether professional or amateur, who are found to possess appropriate talents or a bent toward work of such concrete and scholarly nature.

There is no way to acquire an art but by practising it. The art here suggested has from theoretical importance and practical utility much to recommend it. It has, furthermore, no small charm in itself. As a hobby for the cultivated layman it is hard to imagine a more fascinating pursuit than the gradual assembling of materials and data for such an enterprise. Unhappily members of our small leisure class —using the term even in its most favorable sense—rarely have the requisite intellectual ambition or the needful concentration. Monographic results are much more likely to come from the spare hours of the physician, the lawyer, the banker, the business man. Such persons in gratifyingly large numbers are taking an interest in systematic botany. Around botanical centers there are scores of them, consulting professional herbaria and libraries and building up their private collections. They are active, energetic, gifted with fine enthusiasm, and often decidedly helpful, but as yet they show little ambition beyond the minor problems of their own local floras or the vegetation of the places visited during summer outings. Certainly it should be possible to stimulate such promising material to monographic activity.

As to the professional botanist, I am so optimistic as to have hope even there. After due allowance for those who in quest of microscopic detail or physiological reaction have drifted far from taxonomic interest, after eliminating the overworked whose professional routine in classroom or laboratory depletes every enthusiasm for botanical activity, after admitting that many hours of the academic year and no small portion of the vacation periods must be devoted to text-book writing, popular lectures, summer school instruction, or other remunerative employment to piece out inadequate salaries, still there must be a residuum.

Nearly all botanists in the course of their training or professional work have been consciously attracted by some group of plants. It is well-nigh impossible to occupy oneself seriously with any phase of plant-life without developing such an interest, without coming to have a sort of pet group. Many have had incipient ambitions to make something of such interests. It is reasonable to hope that with increasing facilities from the growth of neighboring collections and libraries more such beginnings may develop to monographic fruition.

Where such an interest can be initiated or revived it could often be pursued with growing enthusiasm. Appropriate groups of plants are of all sizes and degrees of difficulty. Manifestly it would be preposterous for any but the best equipped and already experienced workers to undertake the willows, sedges, asters or œnotheras, not to mention the aroids or palms, but there are hundreds of genera of moderate size still very imperfectly classified—groups where the patient and conscientious attention even of the amateur would bring results

highly interesting to himself and decidedly useful to our science.

Let us do our best to stimulate this intensive examination of particular groups. We *must* do so if we are not to be chiefly dependent upon foreign works of reference. Much as we owe to these foreign treatments—and I am most humble in my respect for many of them—I am convinced that were similar activity to be fostered in America it would have certain merits of its own. There are some prevailing defects in monographs. Many of them lack clarity. Many reach a tedious degree of detail and in their ultimate subdivisions border on the artificial. One reason why I greatly hope that more of my compatriots will engage in monographic work lies just in the fact that there will be limits to their patience, that they will seek the practical, and will in general stop subdivision at the point where distinction becomes inadequate or where further classification would pass the bounds of probable utility.

B. L. ROBINSON

UNIVERSITY CAREERS IN MEDICINE AND SURGERY[1]

A SHORT time ago when the opportunity arose to talk informally with some of you and your classmates, I presented as a general subject, "The selection of a career in medicine." This is an almost impossible topic for anyone to give you final advice upon, since, in order to justly appreciate a given student's abilities and possibilities would necessitate a far wider acquaintance of the individual student's upbringing, environment, and character than is possible for any of your present instructors. However, it does seem as if the possibilities of choice might well be laid before you from time to time in order that you yourselves should fully understand what fields of endeavor are open to you, and that you yourselves may begin to sift out of the many walks in life that particular career to which you find yourselves attracted and by nature better fitted to fulfill. In view of the present dilemma the graduating class finds itself in, it seemed possible that a further discussion of this topic might not be amiss. And since my own life has given me most experience in but a single direction, I have chosen as a title for this occasion, "University careers in medicine and surgery."

As I pointed out on the former occasion, the student may choose broadly between practice and a university career. In the field of practice, he may be physician, surgeon, take up a surgical specialty, restrict his field to internal medicine, X-ray, metabolism, or do everything in that most honorable rôle, the country practitioner. Likewise, if he chooses a university career, he has an equally wide choice varying from any one of the multitudinous laboratory posts to a career in the clinical branches of medicine and surgery.

You will see that I have made the art and science of teaching the dividing line. That is really the great dividing line. Do you want to, are you able to, and will you spend the time necessary to equip yourself for the task of teaching? It is by no means a simple task. In fact, in addition to the difficulties attendant on obtaining a good training and developing one's inborn characteristics, there are many pitfalls for the teacher. The same dangers confront all teachers. The worst of these is self-satisfaction. Many a teacher has, to put it brutally, heard himself deliver hypotheses so often that finally he actually comes to believe ideas that are not entirely supported by facts; he then becomes narrow, dictatorial, and pompous. Such an attitude is less common among instructors in the preclinical sciences and those untrained in laboratory methods. Such men are not real teachers; they are but go-betweens. The real teachers often talk but little and teach to a great part by precept and example coupled with a spoken idea, a suggestion, and a little encouragement. Their methods are to develop the student, not to propound their own views; to lead rather than to drive.

I make some diversion here, since, unless you are endowed with certain qualities and realize what teaching is, you can easily go astray in your choice. But I have especially emphasized teaching as the dividing line because in the last score of years the words research and laboratory have become coupled in medicine with the words success and training. And the impression has been given that the great dividing line in medicine is whether or no one is a researcher or has had a laboratory

[1] Presidential address, Boylston Medical Society, Harvard Medical School, December 15, 1922.

training. Indeed, the phrase "he is an untrained man," meaning untrained in laboratory methods, has been used almost as an opprobrium. This has driven many into laboratory efforts who are neither able nor eager to frequent this field. A true researcher is more a born man than a made product. And so, much time, much precious effort has gone astray. And an immense amount of published effort has appeared that is of no value either to the worker or his readers.

As a further objection to research as the dividing line, I need only point out to you that research can be carried out whether or no one is a teacher. Moreover, it is carried on, and to a large extent by those in no connection with universities. Much, too, of the best sort, for I need only recall to you Sir James MacKenzie's work on the heart as a single example of such extramural effort.

To some extent, teaching also may be criticized as the great dividing line, since medicine is inherently a profession acquired by apprenticeship, a profession for centuries descending regularly in families, where father was the teacher and son the pupil. To such an extent, indeed, all doctors are teachers, and not only of their assistants and colleagues, but of the community at large in which they live. For this latter burden is a part of their very ethics which makes it incumbent upon all medical men to help alleviate suffering whether by prevention and public education, or by dispensing medicine and care when actual disease is present.

Teaching in the university sense, however, has a larger aspect, and it requires a special training and special qualifications. For it involves not only the handing on of known facts, but an ability to stimulate students with a desire to further enlarge the known facts in regard to their profession, and further, a training that can advise and direct such ideas as the student acquires into workable and productive fields. You must realize the vast differences among your own instructors and must recognize that certain of these have added qualities, either naturally or by virtue of special training, that make them both better able to hand on knowledge to you, and more stimulating as regards the breadth of knowledge you are to acquire.

We have, however, a peculiar anomaly occurring in our own time, that though a great teacher is great for the most part through inborn, natural characteristics, and though such a man must be of the greatest value to any school, the schools themselves in the last score of years have not always made appointments with this in mind. As outlined above, research qualities have often appeared to be the potent factor in the choice of faculty incumbents. That is, teaching *per se* does not seem to be looked upon as a prime factor in making appointments to university medical faculties.

Before discussing requisite characteristics for a university position in medicine or surgery, let us define what such a position may be. In the first place, by a university position I mean one wherein teaching and the hospital claim all the efforts of the individual. Practice becomes a secondary factor. The extension of the so-called full time plan of teaching to the clinical branches is something that in this country is still in its infancy. In Germany it has long been a fact, and the division there is based, as I have depicted it to you here tonight, on a teaching position. The German plan, however, does not demand all the clinical teacher's time, as is demanded of a professor of physiology or pathology, which is the modern "American" concept of full time clinical positions, but embraces the underlying principle that the university work is of first importance. The full time plan recognizes the value of education as well as of practice to the community. It is based on the assumption that a great educator in clinical medicine is equally great as a great practitioner of medicine. And the use of preventive as opposed to palliative medicine has been a great incentive. The actual dealing with the sick is an ancient and honorable profession, but the science of preventive medicine is a profession on a still higher plane. That should be the aim of those holding university positions. The full time scheme in clinical medicine substitutes research to be associated with teaching instead of the practice of medicine alone. There are those who claim that men thus devoting all their time to hospital practice can not properly teach students who are to practice by themselves in small, remote communities. These men, however, fail to be convincing, if only

through inconsistency, for they are the very ones who most fully praise Osler's text-book, "The practice of medicine," a work written by a man more than any other an exemplar of this idea.

The fundamental principles are often beclouded. The full time scheme means nothing more than that the incumbents of such positions devote their entire time to teaching and to the hospital. It does not of itself preclude private practice. Indeed, it would appear that there are certain advantages, sufficient indeed to offset obvious disadvantages, should the incumbents of such positions be allowed to have the responsibility and opportunity to see private cases in moderation. The experience and stimulus resulting from this is invaluable, and it is a fatal error to think that a professor of medicine or surgery should only be appointed from those individuals who have already acquired all of the benefits that do accrue from such work.

From the above considerations, it is obvious that the qualities of a teacher and of an investigator are prime requisites for entering upon a university career in medicine or surgery. As has been already stated, a great value has been placed on research, and university posts have, in several instances, been awarded to those whose chief and often only attribute, in so far as eligibility for the position goes, has been that the individual has completed a valuable piece of laboratory work. Such men have naturally not always proved good teachers, and yet even this method of selection has advantages over the older method of choosing the man whose only attribute was his success in the practice of medicine, because in the former case we have a man who at least devotes his entire time to his job. In the latter case, teaching and school work were and often are taken on as incidentals. And yet I must warn you that faculties of reputable schools are still filling important positions with this latter type of individual, so that even should you perfect your training as a teacher, clinician, and laboratory worker, you may still find a man whose chief claim is that he is a successful practitioner as your colleague or chief.

Of course, there is room for all, and the part-time men, as this latter group has been designated, are invaluable in a faculty. Indeed, this type of teacher is not only a valuable asset, but a prime necessity. In the first place, they keep the hospitals and schools in close touch with the community, and they diffuse the knowledge and facts gained by those men in university life best trained to develop such knowledge.

The ideal man for such a position, however, must devote his entire time to his school work. He must, in the first place, have had a broad, general training. Whether he specializes later or not is of only relative importance. He must be acquainted with laboratory methods, not only because he can thereby stimulate his students to, and aid them in solving such problems as come before them, but because of the mental training involved. A training in experimentation involves a training in accuracy. It involves accurate observation, logical deduction, and the bringing forth of conclusions based on fact. It tends to do away with conjecture, ideas based on supposition, hearsay and single isolated observations. And it finally teaches the value of controls. This is a training in thoroughness which no amount of clinical training can equal, partly because in clinical work there is always that "hoodoo" of routine. Certain disconnected things must be done, and then if there is time, the problem which interests the individual can be studied. But how rarely is there time! It is only the very exceptional man who has the physique alone to tackle painstaking investigation on top of the routine of a day's work in a clinic. This is especially true of surgeons whose therapy means hard labor as opposed to the medical man's therapy which in many instances the flourish of a pen leaves to a nurse.

But finally, given a man with a broad clinical training, and one whose published work proves his laboratory training, we still lack something. That something is what makes him a teacher; it is an intangible quality that our language still lacks a proper word to describe. The French call it *l'esprit* and the Germans *geist*, words that now mean one thing and the next another. It is, however, present in all teachers. It is a quality that makes others want to do the same, a certain form of mag-

netism, of stimulus, of optimism. Teachers as well as leaders often work more influence by precept, example, and their own actions than by the spoken word. It is an indescribable quality, and a perfectly worded discourse in which every step rests on proven and established facts may leave the class busy with pencil and paper, whereas another teacher using imperfect diction and presenting his facts in a less orderly fashion may keep every eye and ear so busy that note-books remain untouched. The latter is the real teacher.

These, then, are the essential qualities for the ideal man in university medicine. One does not expect to see them all in full bloom in any individual; but to those of you who contemplate a university career in medicine or surgery, it is well to depict what may be expected of you.

The varied training necessitated will encompass roughly eight to ten years. These years may be divided in the ratio of three to the laboratory and seven to the clinic, and it is my impression that part of the clinical training should come first and part last. It is customary to advise first an interneship, then a resident's post using up perhaps three years; next comes the laboratory. Here the choice must be very wide. It might well be divided into a further training in one of the basic medical sciences followed by two years of experimental endeavor. These years completed, the man steps into the higher resident or assistants' posts in some clinic. From this time on, his mind having been trained in investigative methods, and a greater opportunity for clinical research both as regard material and time being offered, his publications should become true reflections of his value, tendencies, and promise. He now has greater occasion to teach and can well spend a large part of the next few years perfecting what qualities he has in this field. Such a person should now be ready for a high university post.

This is a long span of time, and we may well recollect that life is short. Moreover, the pecuniary reward is small. Still, such posts as those described, except for that of interneship, pay small stipends from five hundred dollars to fifteen hundred dollars. It is not, indeed, the easy task imagined by some of the great group of practitioners who look upon such people as peculiar individuals. But I can tell you that it has high rewards. In the first place, it is always a joy to do work well, and such a training almost insures this. In the next place, to find out the truth by an investigation is a tremendous stimulus. And lastly, it leads to a position in life that keeps one always in contact with vigorous, fresh, inquisitive minds; a position that both keeps one's own mind young as well as gives one the great happiness of seeing other minds grow under a little stimulus, a word of encouragement, or a proper example.

I have, as many of you must know, given much of my own ideas and experiences in this talk; and yet as I wrote it, I had piled on my desk clippings, books, and quotations covering most of the contributions on this subject during the past twenty years. In reading them, I found always the same undercurrent, a feeling that the teachers of medicine must be better trained. What I have written of the ideal man, of his qualities and abilities, is but a summary of the views of others also. It is a description of a field of endeavor for medical men that has been slow to arrive in this country, but which will certainly be in full swing before your generation has passed on.

I beg of you to remember that what I have said is purely from an idealistic point of view. No criticisms have been made. Do not for a moment carry away the idea that I belittle the practice of medicine as opposed to the field of medicine described. I would only have you remember that a university career should require a definite training, if we are to raise medicine to higher levels. Something of what that training must be, and that that training is necessary and logical, I have tried to show you to-night.

ELLIOTT C. CUTLER
PETER BENT BRIGHAM HOSPITAL

IONIZATION AND RESONANCE POTENTIALS[1]

THE phenomena connected with luminous discharge in gases at low pressures have received a great deal of attention during the past twenty years. Many theories have been

[1] Address presented at the Boston meeting of the American Association for the Advancement of Science, Section C.

worked out to explain these phenomena, but until very recently no satisfactory explanation of the relation between the energy necessary to produce ionization of gaseous molecules and the voltage required to produce luminosity in a gas had been advanced. The advent of the electron theory and more recently of the Bohr theory of atomic structure have greatly stimulated activities in this field and it seems likely that most of the facts hitherto regarded as simply empirical will be explained satisfactorily in the near future. It seems probable, at the present time, that a comprehensive theory of the luminous discharge will only be obtained by a thorough study of ionization and resonance potentials. Moreover, research in this field will undoubtedly aid in solving many of the complex problems of photochemistry.

Ionization and resonance potentials can be calculated from the corresponding spectrum lines by the simple relation

$$V = \frac{hc}{e\lambda 10^8}$$

c being the speed of light, λ the wave length of the spectrum line, e the charge on the electron and V the voltage. The resonance potential of an atom is the minimum potential through which an electron must be accelerated when started from rest in order, when it collides with the atom, to displace an electron to an orbit further from the nucleus. There are naturally a great number of resonance potentials for each type of atom, depending on the number of possible orbits to which the electron may be removed. Corresponding to each resonance potential there is a line in the spectrum of the element. Light is emitted when the electron returns to an orbit nearer to the nucleus than the one to which it had been displaced. The light may also be emitted with several frequencies. For example, if an electron had been displaced from the 1 orbit to the 3 orbit it might return to the 2 orbit and then fall back to the 1 orbit after another interval of time. Light of two frequencies would then be emitted instead of the single line corresponding to the 3—1 transition.

When one of the outer or valence electrons has been completely removed the corresponding speed of the impinging electron is called the ionization potential. The light emitted when the electron returns from infinity to its normal position is of the highest possible frequency and this line is the head of the principal series of the element in question. Here again, if the atom is ionized the electron may return by stages and the whole spectrum of the element may be emitted. There may be several ionization potentials corresponding to the removal of one, two or more electrons. Some determinations have been made of the energy necessary to remove a second electron from an atom, for example, to change He^+ to He^{++}, but in general we are concerned with the ionization potential corresponding to the elimination of one electron.

There are several methods of measuring ionization and resonance potentials, but few of the methods distinguish clearly between the two. One method consists in gradually increasing the potential between two electrodes and noting the production of radiation by its photoelectric effect on another electrode placed in the tube. While some idea of the frequency of the light emitted may be obtained by measuring the velocity of the photoelectrons produced, this method does not distinguish definitely between the two types of electron impact. If series relationships for the gas being studied are known, it is possible to obtain some idea of the voltage necessary to produce ionization, but the energy necessary to produce ionization when an atom has already suffered a resonance impact is less than the normal ionization potential, so that results obtained by this method must be interpreted with care. This method has been used by Franck[2] and his coworkers in studying the radiation potentials of mercury.

The three electrode, or even four electrode, tube has been used in measuring ionization and resonance potentials. Many modifications have been proposed. Among the most important might be mentioned those of Lenard,[3], Compton[4] and Davis and Goucher.[5] In most of the methods there is an element of uncertainty due to the velocity of thermal emission of the electrons. While tables have been made out giving the velocity distribution of the electrons at

[2] *Z. Physik.*, 2, 18, 1920.

[3] See Hughes, "Report on Photoelectricity," *Bull. Nat. Res. Council*, 2, 83, 1921.

[4] *Phil. Mag.*, 40, 553, 1920.

[5] *Phys. Rev.*, 10, 101, 1917.

different temperatures, the correction due to this factor may be fairly large. One method of applying it is to place a negatively charged grid in front of the filament so that only those electrons with high velocity will pass through. By measuring the apparent ionization potential of a gas whose ionization potential is known, the magnitude of the correction may be determined. Results show wide variation, however, and the magnitude of the correction undoubtedly depends on the physical state of the filament, the nature of the gas being studied and the potential drop along the filament.

Foote, Meggars and Mohler[6] used a three electrode in which the grid was a spiral wound as closely as possible around the filament. The grid and plate were directly connected together. The electrons were accelerated by the potential on the grid and plate, passed through the grid into the force free space beyond. The radiation emitted between the grid and plate could be photographed and the potential determined at which a given radiation appeared. This method is probably the most accurate of those described.

Recently some work by Gibson and Noyes[7] has shown that in most cases the potential required to produce luminosity in a gas, using a heated cathode, is a simple integral multiple of the ionization potential. According to the theory advanced, it is necessary for positive ions produced in the discharge to reach the cathode in order for the glow to be maintained. The fall of potential in the region between the cathode and the positive column is small, so that the electrons are accelerated in a comparatively short distance. If there are several ionization regions they will be relatively close together. As the potential between the two electrodes is diminished the slowest moving positive ions will be the first to fail to reach the cathode, etc. When all of the positive ions combine with electrons before they reach the cathode, the glow disappears. This will occur when the positive ions formed in the ionization region nearest the anode no longer have sufficient velocity to reach the cathode. The voltage necessary to maintain the glow will, therefore, be equal to the energy of the electron when it arrives at the last ionization region plus whatever energy it may have lost due to inelastic impact before it reaches that point. By studying the disappearance voltage at various pressures with various length tubes it is possible to obtain various multiples of the ionization potential. Subtracting successive values will give the potential desired. Care must be taken in interpreting results obtained by this method, since various combinations of resonance and ionization potentials may be obtained.

The exact method by which the energy of the impinging electron is transferred to the atom is not clear. Whittaker[8] has recently made an attempt at an explanation, but the whole question is in an unsettled state. One fact stands out, however, as a general survey of the field is made, namely, that the agreement between the observed ionization and resonance potentials and the theoretical values computed from spectroscopic data is excellent, leaving little doubt as to the validity of the relationship used.

A large amount of work has been done on hydrogen, due probably to the complete picture which Bohr has given of its atom. Many critical potentials have been noticed, but since the Bohr picture of the hydrogen molecule is apparently considerably in error, the exact interpretation of these potentials is still in doubt. The lowest radiating potential for the hydrogen atom, according to the Bohr theory, should be 10.2 volts. A critical potential of this order of magnitude has been observed by several workers, but, as has been pointed out by Foote and Mohler, there would scarcely be enough monatomic hydrogen present to give this value. The ionization potential of the atom, according to Bohr, should be 13.5 volts and recently Duffenback,[9] by using hydrogen at sufficiently high temperatures, has shown that this value coincides well with experiment. Bohr states that elimination of one electron from the hydrogen molecule without dissociation would leave an unstable ion. There is some evidence, although not at all conclusive, that ionization does occur according to this mechanism. The main ionization potential of

[6] *Phil. Mag.*, 42, 1002, 1921.
[7] *Jour. Amer. Chem. Soc.*, 44, 2091, 1922.
[8] *Proc. Roy. Soc. Edinburgh*, 42, 129, 1922.
[9] SCIENCE, 55, 210, 1922.

hydrogen should occur, however, when the hydrogen molecule is dissociated and one of the two atoms ionized. The heat of dissociation of hydrogen, as determined by Langmuir,[10] is 84,000 calories, which corresponds to 3.6 volts. The main ionization potential of hydrogen should be, therefore, 13.5 + 3.6 = 17.1 volts. This potential has been observed by certain workers, while other workers have obtained lower values. A second ionization potential has been observed in the neighborhood of 30 volts. This would be obtained by the dissociation of the molecule and ionization of both of the atoms. There is some evidence that this is the principle ionization process in hydrogen in long tubes. The difficulty of interpreting the critical potentials in this case is largely increased due to the fact that the gas is diatomic.

The variation of ionization potential with atomic weight for the elements of the first two groups of the Periodic System is approximately what one would predict. The most electropositive elements occur at the bottom of the periodic table and they have the lowest ionization potentials. Little success has been attained in measuring the ionization potentials of the elements in the center of the table. Those which lend themselves to study due to their ready vaporization exist as polyatomic molecules and the interpretation of the critical potentials is exceedingly difficult. Of the so-called electronegative gases, iodine is the only one which has been studied sufficiently to warrant our drawing any conclusions. It would seem that the principle ionization potential of iodine is about 10.0 volts, corresponding to the dissociation of the molecule and ionization of one of the atoms. Since the energy required to dissociate the molecule is 1.6 volts, the ionization potential of the atom should be 8.4 volts. This would correspond to a wave length of 1470 A., but sufficient spectroscopic data are not available to verify this measurement. It is interesting to note that Compton and Smyth[11] have obtained a lower ionization potential for fluorescing iodine than for normal iodine. This agrees with accepted principles, since the fluorescing molecules should be in an unstable state.

Bohr has pointed out that the ionization potentional is not necessarily a function of the electropositive or electronegative character of the elements, but depends on the configuration of the atoms.

The ionization potentials of several compounds have been measured, but it is doubtful whether the data are reliable in many cases. Many compounds are completely dissociated into their elements by electronic bombardment, and the value of the ionization potential as measured may be due to any one of several possibilities. In general the ionization potential of an atom will be different from that of the same atom in combination. It would seem that further careful investigation in this field should be carried out, as it might give us an insight into the real nature of chemical combination.

Foote and Mohler[12] have studied the ionization potential of hydrochloric acid gas and find that it corresponds to simply disrupting the HCl molecule into H^+ and Cl^-. This ionization potential is lower than would be expected, due to the tendency of the chlorine to hold an electron, or in other words to its electron affinity. This agrees well with the idea that HCl is a polar compound.

An atom should be ionized by absorbing radiation of the proper wave length, namely, the same wave length as would be emitted by the reverse process. It may also be ionized by absorbing successive resonance radiations. The principal question before the photochemist at present is whether the action of light is to remove electrons and render the atoms or molecules more "active" or whether they are rendered "active" by displacement of the electrons to different orbits without ionization. It is probable that the rate of reaction of the "active" molecules is extremely rapid, and that the speed of a photochemical reaction depends to a large extent on the speed of ativation. It is impossible to say, at the present time, whether the action of light in chemical reactions is to remove electrons, but it seems probable that this is true in at least some cases. If

[10] *Jour. Amer. Chem. Soc.*, 37, 417, 1915.

[11] *Phys. Rev.*, 16, 501, 1920.

[12] *Jour. Amer. Chem. Soc.*, 42, 1832, 1920.

this is the case, the radiation emitted by a positive ion combining with an electron should be the most efficient in aiding a photochemical action involving the same atom. Here again the problem is complicated if polyatomic molecules are considered. Radiation emitted by a hydrogen atom would probably be without effect on a hydrogen molecule. It has been shown that hydrogen is not activated in the Lyman region. It has been suggested that the study of band spectra might aid in the understanding of this field. Atoms are extremely accurately tuned systems and might not respond to radiation differing in frequency by one part in ten thousand. Whether the same holds true for molecules remains to be determined.

Reactions involving the halogens are peculiarly photosensitive. This may be due to the electron affinity of the halogens, especially in the monatomic state. It is rather difficult to understand why a diatomic halogen molecule should have an electron affinity, and there may be room for difference of opinion on this point. The atoms tend to take up electrons in order to complete their outer shells. The theory at once suggests itself that the effect of light is to disrupt the bond between the halogen atoms, permitting them to combine readily with substances having less electron affinity. As Nernst[13] has suggested, the fact that these reactions do not obey the law of photochemical equivalents can probably be attributed to the fact that one free chlorine atom is formed each time a molecule of chlorine reacts and that this free chlorine atom may disrupt a molecule of the other reacting substance leaving another unstable intermediate product. This series could be continued indefinitely until it came to an accidental end. He tried the use of acceptors in the case of bromine for the purpose of removing the free bromine atoms and found that the law of photochemical equivalents was then obeyed.

In conclusion, it may be stated that while the work done in the field of ionization and resonance potentials has done much to aid our ideas of atomic structure, it has done little from the standpoint of chemical combination. We may look for its development along these lines in the future.

W. Albert Noyes, Jr.
University of Chicago

13 *Z. Elektrochem.*, 24, 335, 1919.

ARTHUR LALANNE KIMBALL

Although Professor Kimball had been in delicate health for several years, and his friends knew that before long he would have to retire from active teaching, the end came with little warning. On the afternoon of October 21 he worked as usual at the laboratory. In the early evening of the following day he passed away.

He was born at Succasunna, N. J., October 16, 1856. Graduating from Princeton in '81 with high honors, he won the experimental science fellowship and was a graduate student and fellow in physics there the following year. From 1882 to 1884 he was fellow at Johns Hopkins, working under Professor Rowland. Here he received in 1884 his doctor's degree, having completed a research on the absolute determination of the ohm. Immediately thereafter he was appointed associate in physics at Johns Hopkins. In 1888 he became associate professor and filled this position with distinguished success until 1891, when he was called to Amherst. Here a new laboratory was built under his direction and for thirty-one years to the day of his death he was conspicuous for ability, friendliness and whole-hearted devotion to the college.

It is probable that his Princeton classmates could have predicted pretty accurately his future. When a man of keen intellect and indomitable will starts in a certain direction his course can be charted in advance. One who knew him intimately writes: "Since the excellence of his moral character, in purity, sincerity, kindness and courage was as marked as his intellectual ability, his studious habits did not keep him out of friendly touch with his classmates, and he shared in our affection no less than in our admiration." At Johns Hopkins his knowledge, his simplicity, honesty and kindliness endeared him to all. With self-sacrificing consecration and high ideals he entered upon his work at Amherst. His clear thinking was matched by his gift for clear

expression, and this fact was appreciated by his students. One of them on coming out of one of Professor Kimball's strikingly beautiful lectures on polarized light was heard to exclaim in a voice of mingled awe and admiration, "Say, fellows, I've sometimes paid good money for a lecture no better than that." A genuine compliment though a bit crude in form. Considerate of all but himself, Professor Kimball overestimated the ability of his body to stand the strain. Repeated sojourns in the Adirondacks served only temporarily to improve his impaired health. But against this background of physical ill his qualities of mind and heart shone with increased lustre. He showed courage akin to that of a wounded soldier on a field of battle. When strength was gone by force of will he carried on.

But the profound influence which this man everywhere wielded is not to be accounted for by gifts of intellect and charm of manner. Just as our physical weight depends partly on what is in us and partly on the planet under us, so a man's moral weight depends largely on the star toward which he strives; and no sketch of Professor Kimball, however brief, should omit mention of the fact that he was a religious man in every fiber. He believed in the church and helped in its work. His was an abundant, beneficent life, and while he enjoyed to the full that which is seen and temporal his character was built on the granite foundation of a faith in things unseen and eternal.

JOSEPH O. THOMPSON

SCIENTIFIC EVENTS

EXECUTIVE BOARD OF THE AMERICAN ENGINEERING COUNCIL

MANY problems of prime importance to the nation and to the engineering profession will be considered by the Executive Board of the American Engineering Council, governing body of the Federated American Engineering Societies, at its next meeting, which has been fixed for March 23-24 in Cincinnati.

The board's sessions will be held at the Ohio Mechanics Institute, President Mortimer E. Cooley presiding. On March 22 the committee on procedure will meet at the Hotel Gibson. Arrangements are under way for a meeting of Cincinnati engineers on the evening of March 23 at which addresses will be delivered by members of the executive board. The opening session of the board will be called at 9:30 A.M., to be followed by an afternoon session at 1:30.

Considerable additions to the membership of the Federated American Engineering Societies are in prospect, President Cooley informed the committee on procedure at its last meeting in New York City. At least a dozen engineering societies are about ready to join, he said. President Cooley was authorized to appoint a committee on increase in membership. John A. Stevens, of Lowell, Mass., has been selected as chairman.

The meeting of the committee on procedure was presided over by President Cooley and was attended by Vice-presidents Philip N. Moore, J. Parke Channing, Calvert Townley and Gardner S. Williams, S. H. McCrory, chairman of the finance committee, and Executive Secretary L. W. Wallace.

President Cooley was authorized to appoint a committee on transportation to advise the executive board at its Cincinnati meeting as to whether or not there are any points in the problems of the transportation of the United States to which the federation could with propriety and effectiveness give attention, and if so, to submit a plan in its report to the executive board.

Max Toltz, of St. Paul, was chosen chairman of the transportation committee. Other members include Con M. Buck, W. H. Hoyt, W. K. Hatt, Dean Perley F. Walker and J. S. Barelli.

The committee on procedure decided that the entire question of immigration was without the purview of the federation and that a committee could not properly be appointed to study any phase of it.

Acting upon representations from the Associated General Contractors of America, to the effect that the seasonable aspects of the building industry as well as climbing construction costs were problems constituting an alarming situation, the committee adopted a resolution "viewing with approval the proposed cooperative movement to remove or reduce the element of seasonable demand in the construction industry."

Willingness to name a committee to cooperate with some responsible agency that will

direct the movement was expressed. President Cooley was authorized to appoint a committee, should he believe it necessary, to cooperate with some authoritative instrumentality such as the American Construction Council or the Associated General Contractors of America.

A "buyers' strike" is inevitable if the present trend of higher prices continues, it was asserted in the statement of the contractors, signed by Managing Director Richard C. Marshall.

The committee on procedure decided that the American Engineering Council would aid in any way within its power and means in bringing about uniform safety legislation. The committee declined to take a stand on the ship subsidy bill, which, it was held, did not come within the scope of the federation's activities.

A communication from W. S. Moody stating that immigration restrictions have so handicapped production that the nation's commercial growth was being hampered was considered by the committee. Suggesting that machinery be used to relieve the shortage of unskilled labor, Mr. Moody said:

> I offer for your consideration the proposition that the council make a thorough survey of industry and select several kinds of work now done manually where great numbers of men could be replaced if power driven devices did the work.
>
> Having selected sufficient fields of such work to release say 500,000 or more hands, I would then have the council recommend to all industry that they associate for this purpose and contribute the necessary money to enable various suitable engineering organizations to undertake the development of the necessary devices for performing this work.
>
> The developmental work should be undertaken by the engineering organization in the same intensive way that similar big production problems were taken up during the war, although, of course, with greater regard for reasonable economy.

The committee voted to submit the question of undertaking an intensive study of labor-saving devices, as outlined by Mr. Moody, to the American Society of Mechanical Engineers.

APPOINTMENTS IN THE U. S. BUREAU OF MINES

CONTINUED growth of the Bureau of Mines, especially in the supervision of leasing operations on public lands, has resulted in the creation of a leasing branch within the bureau, the appointment of another assistant director and several changes of personnel within the organization.

General operations under the leasing act of February 25, 1920, development of lands in the naval reserves and the supervision of operations on Indian lands, have combined to make the federal government an outstanding factor in the production of minerals. Wells drilled on public lands, including the naval reserves, now produce approximately 3,000,000 barrels of oil monthly, or at a daily rate of 100,000 barrels. This production is outside of that from Indian lands. Coal leases and prospecting permits have been issued in fourteen western states, in which the federal government is supervising the operation of eighty-nine mines.

A. W. Ambrose, assistant director, who is specially qualified in petroleum matters, has been placed in charge of the newly created leasing branch. He also will act as a consulting engineer to all branches of the bureau on matters relating to petroleum and natural gas.

D. A. Lyon, chief metallurgist and supervisor of stations, has been appointed assistant director in charge of the research branch, which includes the functions and scope of the former investigations branch after the elimination of leasing matters. For the present, no appointment will be made to the position of supervisor of stations and Mr. Lyon will perform the duties of supervisor in addition to those of head of the research branch.

T. T. Read, having asked to be relieved from his position as chief of the information service and assigned to investigative work, has been appointed a supervising mining engineer. During the absence of F. J. Bailey, assistant to the director, on a visit to the mine safety cars and stations, Mr. Read will serve as the acting head of the operations branch of the bureau and will later be assigned to appropriate field duties.

C. E. Julihn has been recalled from service as chief mining engineer of the War Minerals Relief Commission and made chief of the information service. Francis Winslow, now connected with the division of war minerals

supply, has been assigned to serve with the War Minerals Relief Commission as its chief engineer. J. W. Furness, who has been working with the war minerals supply division of the Bureau of Mines, has been given a permanent appointment in that division.

These changes and appointments are effective as of March 1, 1923.

GRANTS FROM THE ELIZABETH THOMPSON SCIENCE FUND

THE following awards were made at the meeting of the trustees of the Elizabeth Thompson Science Fund on February 24:

No. 241. To Dr. E. Wiedemann, Physikalisches Institut, Universität, Erlangen, Germany, $100 for researches on physical properties of colloidal substances.

No. 242. To Dr. B. Lipschütz, Paltauf's Pathological Institute, Vienna, Austria, $150 for studies of the experimental tar cancer of the mouse.

No. 243. To Mr. A. H. Palmer, U. S. Weather Bureau, San Francisco, California, for maps and photographs.

No. 244. To Dr. E. F. Adolph, Zoological Laboratory, University of Pittsburgh, Pittsburgh, Pa., $250 for electrical equipment.

No. 245. To Dr. Frank A. Hartman, Physiology Laboratory, University of Buffalo, Buffalo, New York, $200 for studies of adrenal function.

No. 246. To Professor James B. Conant, department of chemistry, Harvard University, Cambridge 38, Mass., $150 for a study of a new method of comparing the reactivities of a series of organic chlorides.

No. 247. To Professor C. T. Brues, Bussey Institution, Harvard University, Forest Hills, Boston, Mass., $100 for a study of certain phytophagic races of insects.

No. 248. To Professor G. H. Parker, Museum of Comparative Zoology, Harvard University, Cambridge, Mass., $200 for the study of nerve respiration.

The Elizabeth Thompson Science Fund is administered by G. H. Parker, president; E. B. Wilson, secretary; Charles S. Rackemann, treasurer, and G. P. Baxter and W. B. Cannon, members of the board of trustees. The trustees meet three times a year toward the end of February, of May and of November. Applications should be in the hands of the secretary well in advance of the date of the meeting.

GIFT TO THE ROYAL SOCIETY

SIR ALFRED YARROW, an engineer and shipbuilder of Glasgow, has given £100,000 to the Royal Society for reasons and under the conditions stated in the following letter, addressed to the president:

I would ask you to be so kind as to bring before the council, at an early opportunity, the following proposals:

I have, for many years, held the view that the prosperity of this country has been greatly hampered in the past for the want of better promotion to scientific investigation and its application to practical affairs.

I am convinced that the future prosperity of this country will be largely dependent upon the encouragement of original scientific research. The birth of new industries, and the development of existing ones, are due largely to the growth of science, thus securing employment and the welfare of the whole community being advanced.

It is doubtful whether even yet it has been realized how completely this country would have been at the mercy of our antagonists in the late war, had it not been for the research work done by our scientific men before the war and during its course.

I desire to mark my sense of the value of research to the community by offering, as a gift to the Royal Society, £100,000 to be used as capital or income for the purposes of the society, as the council may think fit, because I recognize conditions alter so materially from time to time that, in order to secure the greatest possible benefit from such a fund, it must be administered with unfettered discretion by the best people from time to time available.

Care must, of course, be taken that a gift from the fund shall in no case lessen any government grant.

In accordance with your practice you would, I assume, appoint a committee to administer the fund, and would also frame rules for the guidance of the committee, while reserving the right to alter such rules from time to time; and I would suggest that they be considered by the council every tenth year so as to meet modern needs.

I should prefer that the money be used to aid scientific workers by adequate payment, and by the supply of apparatus or other facilities, rather than to erect costly buildings, because large sums of money are sometimes spent on buildings without adequate endowment, and the investigators are embarrassed by financial anxieties.

Although I thus give a general expression of my wishes, I do not intend, by so doing, to create

any trust or legal obligation for their fulfilment.

In conclusion, I should like to record my firm conviction that a patriotic citizen can not give money, or leave it at his death, to better advantage than towards the development of science, upon which the industrial success of the country so largely depends.

THE ENDOWMENT OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

MR. ARTHUR H. FLEMING, of Pasadena, for many years president of the board of trustees of the California Institute of Technology and its chief financial supporter, has recently given to the institute his fortune of $4,200,000 as a permanent endowment fund. This gift, with Mr. Fleming's previous donations to the institute, make a total of over $5,000,000. In the trust agreement entered into upon the turning over of this fund, Mr. Fleming has made the following statement of his own ideals for the institute:

The donor is convinced that the institute can best serve the purposes of its existence if its trustees adhere to certain fixed policies and principles, and he therefore earnestly advises and recommends:

That the institute limit its enrollment to not more than two thousand (2,000) students;

That it continue the work it is now doing in the several branches of engineering;

That it specialize in research in chemistry and physics, under the direction of the most competent men obtainable, with the most liberal provision, in the way of salaries and equipment, for the prosecution of such work;

That it seek and invite the superior student;

That it help and encourage those who are disposed to research, but that the utmost care be exercised in the manner of giving such help and encouragement, keeping always in mind that ill-advised or too free-handed assistance begets weakness rather than strength, and that a man should be helped to help himself;

That it use every proper effort to obtain generous endowment funds, to the end that it may be able to make adequate provision for the effective prosecution of research work, pay good salaries to its faculty and obtain the services of educators of the first order; and, lastly,

That it keep its standards of the highest.

The donor is also convinced that the institute should always remain a privately endowed institution.

SCIENTIFIC NOTES AND NEWS

THE executive committee of the American Association for the Advancement of Science recently elected the following vice-presidents of the association for the year 1923, these elections not having been made at the recent Boston meeting: For section L, Dr. Florian Cajori, professor of the history of mathematics, University of California. For section N, Dr. Richard P. Strong, chief, department of tropical medicine, Harvard University Medical School. For section Q, Dr. Henry W. Holmes, dean of graduate school of education, Harvard University.

PROFESSOR LEON J. COLE, of the University of Wisconsin, has been appointed chief of the division of animal husbandry of the U. S. Department of Agriculture.

THE Boylston medical prize of $300, offered every other year by the Harvard Medical School in public competition for the best essay on a subject in medical science, has been won by Professor A. N. Richards and Dr. Joseph T. Wearn, both of the University of Pennsylvania.

THE University of Pennsylvania conferred the degree of LL.D. on Dr. Chevalier Jackson, professor of bronchoscopy and esophagoscopy in the graduate school of medicine of the university, at the ninety-eighth annual observance of Washington's birthday on February 22.

A DINNER in honor of Dr. G. Edmund de Schweinitz, Philadelphia, president of the American Medical Association, was given by the Chicago Ophthalmological Society on March 6.

DR. SWALE VINCENT, professor of physiology in the University of London, has been elected a member of the Paris Academy of Sciences in place of the late Professor Laveran.

THE Weldon memorial prize, which was founded at the University of Oxford in 1907 by friends of the late Professor Weldon, to perpetuate his memory and to encourage biometric science, has been awarded to Dr. Johannes Schmidt, director of the Carlsberg Laboratory, Copenhagen.

PROFESSOR BORDET, of Brussels, director of the Pasteur Institute of Brabant, has been

made a commander of the French Legion of Honor.

DR. CHARLES H. TOWNSEND, director of the New York Aquarium, formerly connected with the deep-sea investigations of the steamship *Albatross,* has been elected a member of the council of the Oceanographic Institute, founded by the late Prince of Monaco.

AT the recent meeting of the American Institute of Mining and Metallurgical Engineers, E. P. Mathewson was made president; T. T. Brewster, of St. Louis, vice-president, and Frank H. Smith, of Spokane, second vice-president. The directors elected are W. H. Aldridge, of New York City; G. H. Clevenger, of Brookline, Mass.; A. N. Diehl, of Pittsburgh; Reno H. Sales, of Butte, Mont., and Seeley W. Mudd, of Los Angeles.

THE following officers of the Royal Astronomical Society were elected at the meeting on February 9: *President,* Dr. J. L. E. Dreyer; *vice-presidents,* Professor A. S. Eddington, Sir F. W. Dyson, Mr. E. B. Knobel and Professor H. F. Newall; *treasurer,* Lieutenant Colonel F. J. M. Stratton; *secretaries,* Mr. H. Spencer Jones and Rev. T. E. R. Phillips; *foreign secretary,* Professor H. H. Turner.

JOHN MORRIS WEISS, consulting chemical engineer, New York, has been selected by the Manufacturing Chemists' Association to serve as their representative on the recently formed sub-committee on benzol poisoning of the chemical section of the National Safety Council.

DR. VICTOR YNGVE has resigned his position with the Hydrol Company, Niagara Falls, N. Y., to accept a research fellowship in cryogenic engineering at Harvard University.

E. L. RIMBAULT, formerly reclamation manager of the National Aniline and Chemical Company, Inc., at the Buffalo plant, has been appointed manager of the intermediates and certified food color divisions.

DR. SIMEON B. WOLBACH, of the Harvard Medical School, Boston, and Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, New York, are conducting at Hamilton, Montana, research work on Rocky Mountain spotted fever. Their work will continue for several months.

PROFESSOR REID HUNT, of the Harvard Medical School, has been appointed visiting professor at the Peking-Union Medical College.

DR. HANAU W. LOEB, dean of the St. Louis University School of Medicine, sailed from San Francisco on February 22 for a tour of the Orient. During his trip Dr. Loeb will visit the medical schools of Japan, China and the Philippines.

PROFESSOR WILLIAM H. HOBBS, of the University of Michigan, will attend the Pan-Pacific scientific congress to be convened at Sidney and Melbourne, Australia, from August 13 to September 4, by special invitation of the Australian government. He will deliver several papers on the topic of Pacific geology. In his absence Dr. Jesse P. Rowe, professor of geology at the University of Montana, will serve as the head of the department during the summer session.

PROFESSOR THE. SVEDBERG, University of Upsala, Sweden, who is conducting classes in colloid chemistry in the University of Wisconsin chemistry department during the second semester this year, has been invited to attend the dedication ceremonies of the Sterling chemical laboratory at Yale University on April 4.

THE new research laboratories of the General Electric Company, Ltd., Wembley, England, were opened on February 27, when Lord Robert Cecil and Sir Joseph Thomson delivered inaugural addresses.

A JOINT meeting of the Washington Academy of Sciences and the Philosophical Society of Washington was held on March 10, at which Professor A. Sommerfeld, of Munich, delivered an address on "Evidence for the theory of relativity afforded by atomic physics."

DR. LEON ASHER, professor of physiology at the University of Berne, Switzerland, delivered a series of lectures on "The physiology of the lymphatics" at the St. Louis University School of Medicine from March 5 to 9.

PROFESSOR ROSS G. HARRISON, of Yale University, recently gave two lectures on "The life of the tissues outside the body" before the University of North Carolina chapter of the Sigma Xi.

MR. FRANCOIS E. MATTHES, of the United

States Geological Survey, gave an illustrated lecture before the New York Academy of Sciences at its general meeting of March 5 on the "Evolution of the Yosemite Valley." He also spent a day at the American Museum of Natural History inspecting the new large relief model of the Yosemite Valley that is being prepared under the direction of Dr. E. O. Hovey.

PROFESSOR C. J. CHAMBERLAIN, of the University of Chicago, delivered on March 3 an address at Toronto to the Royal Canadian Institute on the subject "Ancient plants."

PROFESSOR F. S. HAMMETT, of the Wistar Institute of Philadelphia, delivered a lecture before the Royal Canadian Institute at Toronto on February 24 on "The glands of internal secretion and their functions."

DR. CHRISTINE LADD-FRANKLIN, of Columbia University, gave an illustrated lecture on January 23 at Harvard University under the auspices of the department of psychology, on "Theories of color sensation."

DR. HARRY HARKNESS STOEK, since 1909 professor of mining engineering, University of Illinois, died suddenly on March 1, aged fifty-seven years.

PROFESSOR JOHANNES DIDERIK VAN DER WAALS, of the University of Amsterdam, died on March 8. Dr. Van der Waals received the Nobel prize for physics in 1910.

WALTER WILLIAM BRYANT, senior assistant in charge of the magnetic and meteorological department of the Greenwich Observatory, died on January 9, at the age of fifty-eight years.

ALFRED HENRY FISON, lecturer on physics at Guy's Hospital, was killed while installing wireless apparatus at the hospital on February 4.

BERNARD BOSANQUET, a distinguished English writer on philosophy and logic, died on February 8, at the age of seventy-five years.

THE death is announced of Gaston Bonnier, professor of botany at the Sorbonne, Paris.

IT has recently been brought to the attention of the council of the Harvard Travellers' Club that the rifle presented by the club to Mr. V. Stefansson in May, 1913, was stolen some time in October, 1914, probably from a wharf in Esquimalt, B. C. The rifle was a .256 bore Gibbs Magnum Mannlicher-Schoneaur, No. B 6029. Any information as to the present whereabouts of this rifle will be gratefully received and a suitable reward will be paid to the informant. Communications may be addressed to the president of the club, Professor Theodore Lyman, Jefferson Physical Laboratory, Cambridge, Mass.

THE United Civil Service Commission announces an examination for assistant in fisheries investigations in the service of the U. S. Bureau of Fisheries, to be held on April 4, 1923. Applicants will be rated chiefly upon general biology and zoology in relation to the fisheries. There are to be filled from this examination one position of field assistant in the Fisheries Service at large, at $1,200 per year; two positions of scientific assistant at $1,200, one at Fairport, Iowa, and one at the Washington, D. C., office; one in the position of fishery expert, in the steamer *Albatross,* at $1,400 per year, and vacancies in positions requiring similar qualifications at higher or lower salaries. All of these positions carry the present bonus of $20 per month. Applicants should apply to the Civil Service Commission, Washington, D. C., for form 1312, stating the title of the examination desired.

THE French Société de biologie will celebrate its seventy-fifth anniversary on May 26. Delegates are expected from its affiliated societies, seven in France and one at Petrograd, Buenos Aires, Lisbon, Athens, Copenhagen, Bucharest, Cluj and Jassy, Stockholm and Lithuania and from the Société belge de biologie. Three questions have been selected for discussion: "Generation and fecundation," "Physiological action of potassium and calcium," and "Immunity in invertebrates."

THE thirty-fifth German Medical Congress will be held in Vienna from April 9 to 12, under the presidency of Professor K. F. Wenckebach, when there will be discussions on encephalitis lethargica, introduced by von Economo of Vienna and Nonne of Hamburg, and on high arterial blood pressure, introduced by A. Durig, of Vienna, and Volhard, of Halle. One afternoon will be devoted to demonstration of patients with endocrine disturbances.

THE Aztec ruin, near the town of Aztec, N. M., donated to the government by the American Museum of Natural History, is established as a national monument under a proclamation issued by President Harding. The prehistoric ruin which is thus placed under the jurisdiction of the National Park Service of the Interior Department, is the best preserved of all the ruins in that vicinity, and its designation as a national monument will assure its preservation to posterity. The ruin, one of the well-known Pueblo type, is a large E-shaped structure of approximately 500 rooms with the entire first story standing and many of the second floor rooms intact. The ceilings are supported by large beams, cut and dressed with stone tools, while the walls are of sandstone with dressed faces, and as examples of prehistoric masonry are said to take high rank. Excavation of the ruins has been carried out during the last five years by the American Museum.

THE *Journal* of the American Medical Association states that it is announced by Dr. Henry Hanson, director of public health for the Republic of Peru and of the Peruvian yellow fever campaign carried out by the Rockefeller Foundation and the government, that Peru is free from yellow fever for the first time in history. There have been no cases reported since August, 1921, so that practically the whole western coast of the Western Hemisphere may be said to be cleared of the disease.

THE British Industrial Fatigue Research Board has issued a report containing two documents, one, on the influence of temperature and other conditions on the frequency of industrial accidents, by Miss Ethel E. Osborne and Dr. H. M. Vernon, and the other, on the relation of fatigue and accuracy to speed and duration of work, by Mr. B. Muscio.

THE first of the William Beaumont Foundation lectures, given under the auspices of the Wayne County Medical Society, Detroit, has been issued in book form. Dr. W. G. MacCallum, professor of pathology in the Johns Hopkins University, delivered the first lecture. This series of lectures is the outgrowth of a patriotic fund created during the war for the purpose of assisting needy families of the medical society who were in war service. After the fund had served its purpose, the contributors redonated the substantial surplus to the progress of scientific medicine.

DR. CHAS. F. SHAW, professor of soil technology at the University of California, is taking a six months' sabbatical leave from February to August, and will visit the Hawaiian Islands for six weeks, proceeding to Australia with a brief stop at the Fiji Islands, returning through New Zealand, Raratonga and Tahiti. He is planning to observe soil condition in the Hawaiian Islands, particularly on the Islands of Hawaii, Oahu and Kauai, representing three very distinct stages in soil formation. In Australia he will study the character of the soils, particularly those of the new regions that may be opened up for settlement through the development of the Darwin and Murray rivers, and will also try to determine whether or not the soil zones that have been observed in Europe and on the American continent are developed on the Australian continent. Two weeks will be spent on the north island of New Zealand mainly in sightseeing. Dr. Shaw will bring back representative samples of soils from Australia both for the University of California and for the laboratory of the Bureau of Soils at Washington.

AT a recent meeting of the Board of Regents at the University of Michigan the president of the university filed a statement from Professor A. G. Ruthven with regard to the anthropological expedition to the Philippines. Dr. Guthe, the director of the expedition, wrote: "The collection already at hand is far beyond my wildest dreams. The unbroken pieces alone number well over one hundred. There are undoubted specimens of T'ang, Sung, and Ming ware. The possibility for comparisons and study in these wares alone overwhelms me. In addition to Chinese ceramics there are unglazed pieces, and a goodly amount of beads, implements, skeletal material, wooden objects, etc. Gold and iron is not uncommon. We know at present of at least thirty caves and ten burial grounds which are more than likely to yield results. The islands seem to be full of the stuff."

THE *Journal* of the American Association reports that the Academy of Medicine at Paris

has fifty-nine endowed prizes to award in 1922, and 133 articles were received in competition. This year again the secretary commented on the handicap resulting from too specific directions in regard to the awarding of a prize, as conditions change rapidly from year to year. During the year, two new prizes were endowed: one pertaining to questions of general hygiene and the other to the medical treatment of facial neuralgia. The Herpin prize, for the "Abortive treatment of poliomyelitis," was awarded to Dr. A. Pettit of the Pasteur Institute, for his results with his antipoliomyelitis serum. He takes for the antigen the virulent medulla of monkeys. This year again the Audiffred prize "for a sovereign remedy for tuberculosis," consisting of a 3 per cent. government bond and representing an income of 24,000 francs, was not awarded, although six competing works were received. Nineteen of the prizes were not awarded; no competing articles were received for four of them. The recipients of the prizes were all physicians in France or the French colonies, with the exception of Professor C. Pezzi, of Milan, who shared with Laubry of Paris a prize for their "Manual on congenital heart disease." All but ten of the prizes are open to international competition.

THE Kaiser Wilhelm Institute for medicosocial education, which was formerly the Kaiser Wilhelm Academy for the advancement of military medicine, is to be transformed into a government institute for medical research. This institute, which was completed a few years before the war, is to turn over its excellent laboratories and its library, which is probably the largest medical library in Germany, to the service of scientific medical investigation.

R. B. MARSTON, editor of *The Publishers' Circular and Booksellers' Record,* London, writes to the London *Times* as follows: "With reference to the letter from Miss Charlotte Mansfield stating that a number of German publishers refuse to sell their chemical books to non-Germans, I am informed by authorities in the German book trade in Leipzig and Berlin that Miss Mansfield has been misinformed. There is no ban on the export of German works on chemistry or any other subject. Every German publisher is very glad to sell his books—chemical or other—to non-Germans; but what may have given rise to the idea of refusal to export is that, owing to the great fall in the exchange value of the mark, German publishers are compelled to put a surcharge of 200 per cent., more in some cases, on copies exported to England and other countries. The German government supports the efforts of the book trade to protect itself in this respect, and customs officials at the frontiers are instructed to see that the surcharge is made. German publishers of expensive scientific works insist on a declaration in writing that purchasers in Germany will not export the works unless this surcharge is made—even then the cost to the English or other importer is still very low. During the war suggestions were made that some restraint should be put after the war on the world-wide dissemination of German science, but beyond this surcharge, which applies to books of all kinds, nothing has been done in this direction. I have experienced no difficulty in getting German military and technical works and find them, in spite of the surcharge, cheaper than before the war in most cases."

UNIVERSITY AND EDUCATIONAL NOTES

THE site at Woodland Avenue and Forty-second Street, Philadelphia, for the new buildings of the Philadelphia College of Pharmacy and Science, was dedicated February 23. Rear Admiral Braisted, former surgeon general of the navy and president of the college, delivered the dedicatory address. It was announced that more than $1,000,000 had been collected since last November in the campaign for $2,000,000 for the erection of buildings. The college was founded by Benjamin Franklin.

THE department of bacteriology of the University of Chicago will occupy this month its new laboratory, to be known as "Ricketts Laboratory South." Ricketts Laboratory South is a fireproof building, one story in height, situated a few yards to the south of Ricketts Laboratory, and has been erected at a cost of $50,000. Like Ricketts Laboratory, it bears the name of Howard Taylor Ricketts, assistant professor in the university, whose researches in typhus fever led to the discovery of the

remedy for that great scourge, and who lost his life in Mexico City in May, 1910, from the fever which he was engaged in studying.

WE learn from the *Journal* of the American Medical Association that a campaign was opened in December in the United States to raise funds for the medical schools for women in India, China and Japan, which, if secured, would insure a gift of $500,000 from John D. Rockefeller. Dr. Tehyi Hsieh, Dr. Ida Scudder, principal of the Women's Medical College, Vellore, India, and Dr. Mabel M. Manderson, former dean of the North China Medical College for Women, Peking, toured the United States lecturing for this movement. It was announced recently by the Woman's Foreign Missionary Society of the Methodist Episcopal Church that more than $2,800,000 had been raised for the six oriental colleges for women.

ASSOCIATE PROFESSOR C. M. SPARROW, of the University of Virginia, has been promoted to a full professorship of physics.

AT the University of Cambridge, Mr. J. B. S. Haldane, New College, Oxford, and Trinity College, has been appointed Sir William Dunn's reader in biochemistry, Mr. A. Hutchinson, Pembroke College, university lecturer in crystallography, and Dr. C. Shearer, Clare College, university lecturer in embryology.

DISCUSSION AND CORRESPONDENCE

RADIATION A FORM OF MATTER: UNPROVEN

WHAT is there about relativity that compels so many of its expositors to confuse terms hopelessly, to fail to distinguish between definition and proof, to adopt a spurious logic that would never be countenanced in another connection? Can it all be accounted for by the mental confusion that usually attends the use of well-known words to denote ideas that are new and more or less foreign to those previously denoted by them? Questions of this kind arise on reading such articles as Professor A. H. Compton's letter entitled "Radiation a form of matter,"[1] in which he claims to have demonstrated "that, according to the common significance of the word, radiation must be considered as a form of matter."

His demonstration consists of two parts. First, he maintains that the existence of radiation pressure is proof that the radiation possesses mass; second, matter has been defined as "that which possesses mass or inertia"; hence radiation is matter.

That the first conclusion involves a logical fallacy should be evident to any one who is acquaintd with the thump that can be given by a compressional wave traveling along a spiral spring, even though he were unacquainted with the physics of the prerelativity era. The existence of radiation pressure shows that there is a transmission of momentum with the wave, but this does not require that the inertia concerned with this momentum pertains to and travels with the radiation.

As regards the second part of the demonstration, it should be evident that nothing new can be proven by a verbal definition. We are concerned with groups of phenomena, ideas, concepts, not with mere words. Definite words are chosen to denote definite groups of phenomena, ideas or concepts; and it is only as we comprehend these that we understand the true significance of the word.

If a word is used to denote but a single property, then its definition merely names that property; for example, "Energy is the capacity for doing work." Such definitions are equivalent to mathematical identities; having found that one of the two terms of the definition is applicable to a given case, it is a mere truism to say that the other is likewise applicable, it adds nothing whatever to our knowledge of the subject under consideration. Such definitions classify by means of a single property, connotate nothing, convey no implication either of similarity or of dissimilarity between other properties of the items that are grouped together by this classification.

If a word denotes, not a property, but a group of units each possessing many properties, some common to all units of the group, others differing from unit to unit, the proper conception of the significance of the word can be conveyed best in the manner employed in educating infants, by pointing out numerous diverse units belonging to the group. The verbal definition of such a word must be ex-

[1] SCIENCE, 52, 716, December 22, 1922.

ceedingly complex if it is even approximately complete. In practise, the definition of such a word is designed to serve merely as an aid to classification, and consists in the naming of only a few properties, in many cases of but one, that appear to be common to all units of the group and to be possessed by no unit belonging to any other group, all other properties common to the several units being connotated only. Definitions of this connotative kind can never be regarded as final, nor be used to prove that a given unit is properly designated by the word defined. If the properties of the unit in question are such as to conflict with the connotations of the definition, then the proper conclusion is that the verbal definition is unsatisfactory, that it does not serve to distinguish unambiguously from other units those of the group designated by the word defined. To adopt any other policy is to deny that there is any connotation, to claim that the word merely designates the property or properties named in the definition; in other words, to claim that the definition is of the kind previously considered.

As commonly used, "matter" and "material" denote a group of units that possess many properties; verbal definitions of them must be connotative. This appears to be recognized by Professor Compton. The use he makes of the definition is therefore invalid. In order to establish his thesis, he must show, by other than an appeal to verbal definitions, that radiation is indeed a unit of the group denoted by the word matter, that it satisfies the connotative demands.

In the first paragraph of the letter we find the expressions "conservation of matter," "conservation of mass" and "mass or inertia." The terms matter, mass, inertia appear to be regarded as synonymous. Certainly the concepts designated by "matter" and by "inertia" are quite distinct. The terms matter and material, as commonly used, refer to aggregations of what we are pleased to call atoms. Such aggregations have been found to possess both weight and inertia. It is the first of these, the one that determines the value of m in the gravitational equation, that has been found experimentally to be conserved. The second term, inertia, determines the work that is required to give the aggregation a specified velocity. The two concepts are quite different and should not be confounded. Experiments indicate that the ratio of the weight of such an aggregation to its inertia is a universal constant, the same for all such aggregations; but it should not be forgotten that this truly surprising relation has been established solely for aggregations of atoms. I know of nothing that will justify the conclusion that the possession of inertia universally implies the possession of weight. When these different concepts are kept clearly distinct, the difficulty of establishing the proposed thesis is increased. In truth, the thesis in general appears untenable.

If the words "matter" and "inertia" are redefined as identical concepts denoting a single property the quantity of which differs from energy by only a universal constant, then, and probably only then, can the thesis in general be maintained.

Redefinitions appear to be essential to the relativity theory, but they are in general unavowed and unrecognized by the expositors of that theory. Terms so redefined do *not* denote the same concepts as they did before, and much of the utter nonsense that has been written about relativity is attributable to a failure to recognize the differences so introduced. Is it superoptimistic to hope that in the near future expositors of relativity will consider carefully and inform their readers of the actual significance of the terms they use? Care in this respect, combined wih the elimination of inconclusive and invalid arguments, will be of great service to both the physicist and the layman. Incidentally, it will reduce the volume of relativity literature that one has to read; but that need not be considered here.

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RIGHT AND LEFT HANDED SPEAKERS

THE subject of right and left handedness periodically has evoked interesting discussion in the columns of SCIENCE, but I do not recall mention of a fact which I frequently have verified by observation, namely, that there are right and left handed speakers. Given an audience hall of oblong dimensions where the

speaker stands in the center of one side and not at the end, unless he be a practiced speaker he usually will address the majority of his remarks, be they written or impromptu, towards one or the other end of the hall, depending upon whether he be right or left handed. In illustration, I recently listened in a hall of this description to two cultivated Englishmen. One was an orator accustomed to speak in the House of Parliament, where the audience surrounds the speaker on all sides. He turned equally to the right and left of his audience, but the other, a general, more accustomed to the battlefields than the rostrum, gesticulated with his right hand so forcefully that he pulled himself around to face his audience upon his right, to the almost complete ignoring of those seated upon his left. Meanwhile, in his embarrassment, with his left hand he clung to the lapel of his coat, which further precluded his turning towards that side!

In a medical lecture hall into which an adjoining room often is thrown open to accommodate an overflow audience, there is a narrow but tall reader's desk at the center of one side. It is amusing to note that the right-handed speaker often leans upon this desk with his right arm, thereby turning himself to address his audience upon his left, but should be remove his right arm to gesticulate (which medical speakers from the nature of their subject rarely have occasion to do), he pulls himself around to face the opposite end of the wide but narrow hall. The left-handed speaker does the reverse. As the majority of speakers are right handed, I have found it an advantage for hearing to sit in the audience upon their right side, unless there be a tall reading desk, when it is safer to sit upon their left!

Related to this topic is the question of right and left eyedness, which was discussed in SCIENCE some time ago. Apart from any question of possible difference in acuteness of vision is the fact that many persons can not close the two eyelids with equal facility, which sometimes may account for poor marksmanship. In sighting a shotgun, for instance, from the right shoulder, if one instinctively closes the right eyelid much more readily than the left, in order to use the left eye one must bring the head much further over toward the stock of the gun, and failure to do this quickly and completely results in poor aim, particularly in rapid firing, as in taking birds on the wing.

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THE BIRD COLLECTOR

FROM the article of Joseph Grinnell in your December 15th issue, one would infer, first, that the toll taken by collecting ornithologists is negligible; and second, that it makes no difference anyway since the factor of safety is so large. However true this may be with respect to the dominant species, it certainly is not so when it comes to forms that are rare, either absolutely or locally. When a species once gets on the down grade, the hand of every man with a gun, especially if he be an ornithologist, is against it. There is no deadlier adventure for a rare bird or one which has ventured out of its ordinary range than to meet a bird lover of the collecting type. One might think that the ornithologist-conscience would prevent abuses in this line, but my experience indicates that in this variety of the human species that mental organ is purely vestigial; while among commercial collectors, for whose existence the ornithologist is chiefly responsible, it is non-existent. For example, a few years ago a pair of avocets (formerly abundant, but now very scarce in western Nebraska) bred in a marsh near Grand Island. The following year, this colony was increased. The news of this brave attempt to regain some of its lost territory reached the ears of a collector in Lincoln, who promptly went out and exterminated the colony.

The last specimen of the British sea-eagle passed away not long ago. Paid persecution brought its numbers to the danger point; but after the reward for killing it was withdrawn, it might easily have maintained itself but for the selfishness of collectors, who shot every available specimen for "preservation." To this the scientific bird-man will doubtless reply: "Tush! When a species is dying out or trying to extend its range, it will do so regardless of collectors." But to the non-partisan mind such protests naturally raise a question as to the protestor's sincerity or accuracy. The indictment of Douglas Dewar anent the hoopoe will strike many a responsive chord. In his

Bombay Ducks, p. 146, he says, "The hoopoe frequently visits England and would breed there if it were allowed to do so; but the moment the beautiful bird sets foot on our shore it is shot by some collector, who then proceeds to boast about his exploit. The consequence is that the hoopoe is a very rare bird in England, and is likely to remain so until severe measures are enacted against that enemy of nature, the collector of birds."

What is to be done? As one who believes that for the greatest good to the greatest number, it is more important to save the rare birds than have them run the risk of extermination in the interests of science, I believe the killing of such birds should be absolutely prohibited. Their appearance can be taught by carefully prepared plates or by skins protected by double glass-plates. If any one believes that it is absolutely essential to human welfare or to that of his guild that they be "collected," let him show the faith that is in him by going after them and standing up for fine and imprisonment like a man. For the species that are beginning to be rare, or better yet, for all harmless birds the laws should permit them to be shot only by accredited representatives of scientific institutions. Furthermore, all teachers and others engaged in promoting the interests of young people in wild life should discourage the collecting impulse as unsocial in its ultimate results. To test the logic of this position merely imagine what the result of the opposite course would be. Suppose all children throughout the land were urged to provide themselves with guns and to start collections of birds and eggs. What would this do to the factor of safety for the rarer birds?

H. GIFFORD

THE ACTION OF SODIUM HYDRATE UPON THE COMPOSITION AND DIGESTIBILITY OF GRAIN HULLS

IN an earlier publication of this journal,[1] a brief account was given of studies made at this station on the effect of dilute solutions of sodium hydrate on the composition and digestibility of grain hulls and other fibrous material.

Since this first report was made additional work has been done with barley hulls, cotton-seed hulls and flax shives. It has been found that the soda solution had a pronounced influence in improving the digestibility of the barley hulls but that it was substantially without effect upon the digestibility of the cotton-seed hulls or flax shives. A special study is being made of its action upon the digestibility of the pentosans, fiber and lignin. It is intended to study the effects of other methods of treatment including the action of other chemicals upon grain hulls and similar materials.

J. B. LINDSEY,
J. G. ARCHIBALD
MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

[1] SCIENCE. Vol. LV, No. 1414, p. 131, February 3, 1922.

STENOMORPH, A NEW TERM IN TAXONOMY

IN the study of shipworms I have found that larval forms of various species seem to show no selective powers as far as the size of the wood to which they have attached themselves is concerned. It therefore happens that we find the same species growing in timbers sufficiently large to enable it to attain full size, which in different species varies from six inches to three and a half feet in length, and from a few millimeters to almost an inch in diameter; or the larval forms of the same species may attach themselves to a piece of lath or a twig and completely honeycomb this, just as they do the larger piece of timber, reaching sexual maturity in this state. Forms under such conditions are dwarfed and while they have the structural features of the larger species, these are all reduced correspondingly in size. To such forms distinct names have been given by some authors who did not understand the true inwardness of the situation. For such diminutive forms produced by their cramped habitat I wish now to propose the term *stenomorph*.

Specimens coming under this designation will probably be found in all species of shipworms as well as other boring and nestling mollusks and probably other groups of organisms.

It is more than likely that specimens grown in the small 2 x 4" test blocks, placed in various waters of our country by the Committee on Marine Piling Investigations of the National Research Council, will produce stenomorphs of the various species.

PAUL BARTSCH

BOTANICAL LITERATURE FOR RUSSIA

THE world's war and the following events tore Russia away from the civilized world and stopped any access to its scientific literature. Now that normal relations between our country and its neighbors are being partly restored and the scientific literature of Western Europe begins little by little to penetrate into Russia, we are still deprived of North American publications. At the same time the financial conditions of our country are such that we are unable to purchase them from booksellers. This leads me in the name of the laboratory under my supervision to address botanists of the United States and to ask for help in our scientific work by sending copies of recent papers, books, etc. We shall be glad to send in return our publications.

CONST. MEYER

BOTANICAL GARDENS,
UNIVERSITY OF MOSCOW

SCIENTIFIC BOOKS

The Biology of Death. By RAYMOND PEARL. Philadelphia: Lippincott, 1922.

In many fields of scientific research, where progress is most active, the old barriers which have so long separated men of like mind and partitioned off congruous subjects are now disappearing. This fact is widely recognized in the case of physical chemistry, of general physiology, and of atomic physics. But there could be no better illustration of it than the new monograph on experimental biology, "The Biology of Death." Professor Pearl, an experimental biologist, has not found it necessary to change either his point of view or his methods of research in taking up his duties as professor of vital statistics, and in his first book dealing with the subject of his new chair he has drawn upon a wide variety of sciences, including cytology, pathology, genetics and statistics, without sacrifice of unity and with the happiest results.

The book opens with two questions: "Why do living things die?" "Why do living things die *when* they do." Pearl's answer to the first question may perhaps be stated as follows: Single cells, whether unicellular organisms, germ cells or somatic cells, die only by chance. All cells are potentially immortal. The proof of this statement is to be found in the work of Woodruff on *Paramecium,* of Jacques Loeb on artificial parthenogenesis and especially of Harrison, Leo Loeb and Carrel on tissue culture. Normal death in the metazoa is due to the wearing out of units of a higher order than cells, it is a result of the specialization of structure and function of the highly differentiated multicellular being.

It seems to me that this is probably a sound inference. Nothing could be plainer than the fact that death from valvular disease of the heart, or from cirrhosis of the liver, or perhaps from diabetes, corresponds with Pearl's statement. The conception also has the advantage of being analogous to our ordinary view of the wearing out of useful objects. Thus we wear out our boots or their soles, but the molecules of which they are composed remain unchanged. Indeed an aggregate of aggregates must be more unstable, in certain respects, than its component aggregates, for its existence depends upon the integrity of each component and of the relations between them. But it must be confessed that, until certain phenomena of senescence such as desiccation and the more conspicuous intracellular changes can be clearly accounted for, doubt will remain regarding the complete validity of any statement concerning this question, simply because we shall continue to feel uncertain of the exhaustiveness of our analysis.

In answering the second question Pearl turns to his own researches and classifies the causes of death "under the heads of the several organ systems of the body, the functional breakdown of which is the immediate or predominant cause of the cessation of life." A statistical treatment of the data, founded upon this classification, leads to the conclusion that the causes of death operate in a very orderly and regular manner, the biological significance of the regularities being, as a rule, not difficult to understand. Thus, in the first year of life the alimentary tract is to be charged with the greatest number of deaths, for the next fifty years of life it is the respiratory apparatus which takes first place, in old age the circulatory system.

From these facts the conclusion is drawn that advancement of the physiology, pathology and hygiene of the respiratory organs should

take a very high position in our effort to promote the health of the community and to lengthen human life.

Another and more compact biological classification of the causes of death depends upon the discrimination of the germ-layers from which the different organs arise. This yields the result that parts of endodermal origin are the most vulnerable (fifty-seven per cent.), those of ectodermal origin the least (about ten per cent.).

This subject is followed by a presentation of the evidence, first from statistics on men, then from Pearl's own interesting experimental studies of *Drosophila*, that length of life is inherited in a normal manner. Especially after an examination of these experimental data it is impossible to escape the conclusion that, other things being equal, duration of life follows the Mendelian laws, or the impression that further information and perhaps novel discoveries must result from the study of so unique a character.

But how far does environment modify the hereditary length of life in man? What is the accidental, what the preventable shortening of human life? To the analysis of this question much space is devoted. First comes the evidence that the expectation of life at birth in civilized communities has been increasing over a period of two thousand years. No doubt as a result of this fact, the expectation of life at advanced ages has meanwhile been growing less. It is difficult to see how these facts can be fully reconciled with another statement arising later from experimental evidence "that environmental circumstances [probably] play their part in determining the duration of life, largely, if not in principle entirely, by influencing the *rate* at which the vital patrimony is spent."

So far as the prospects of further great increases in the length of life are concerned, it is not surprising to find Pearl a moderate seeptic. Like yellow fever in the past, other diseases will no doubt be conquered by scientific methods in the future. Still others will be more and more restricted. But, on the other hand, it seems clear, according to Pearl, that some effects of preventive medicine are much over-estimated, partly through our ignorance of epidemiology, partly because of the sentimental enthusiasm of ignorant optimists. On the other hand, "the inherited length of life" definitely limits the progress that can be made through the agency of applied science. At this point the doubtful question seems to be how much progress can still be made before diminishing returns check further increase of effort. Pearl's opinion seems to be that long before the expectation of life at birth in the United States has been lengthened by thirteen years (a fair estimate of the effect of elimination of all preventable deaths) the law of diminishing returns must put an end to substantial progress. It is interesting, if only academically, to note that selection of long-lived stock, as in Pearl's *Drosophila* experiments, would rapidly lead to much greater results. These conclusions are reinforced by the fact that the death rate of the earliest period of life, and presumably of all periods, is selective. On the other hand those both of whose parents survive to the age of eighty live twenty years longer than those neither of whose parents reach the age of sixty.

This interesting book closes with the discussion of what is perhaps its most important contribution to the problem of population, the theoretical population curve of Pearl and Reed. This curve, which was developed from a simple hypothesis, has the formula

$$y = \frac{b}{e^{-ax} + c}$$

x being time and y population. It is a curve which also arises from the discussion of other natural phenomena and it fits the facts of population in a large number of independent cases with truly remarkable accuracy. With its help the discussion of the population of the United States leads to the conclusion that the *present* growth of population in this country is approaching a maximum of about 197,000,000 and that, unless some other new phenomena of growth or decay should be added, this maximum will be nearly reached in one hundred years.

A book so full of complex problems vigorously treated can not fail to arouse both interest and opposition. It is safe to say, however, that Professor Pearl has done an important work of scientific synthesis which must encourage and disseminate clear, critical, un-

sentimental thinking about one of the greatest of social problems.

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SPECIAL ARTICLES

OCCURRENCE OF HUMAN REMAINS WITH PLEISTOCENE FOSSILS, LAGOW SAND PIT, DALLAS, TEXAS

THE closing of the Lagow Sand Pit, Dallas, Texas, is a matter of regret to students of Pleistocene fossils in the southwest. This sand pit has been operated for seventeen years, excavating an area of about five acres. The pit is a part of a large featured terrace which follows the Trinity River for a number of miles. The top of the terrace is about fifty feet above the flood plain of the stream. The number of fossil finds has been large, though few of the finds have been saved. Of the fossils now preserved in the museum at Southern Methodist University, Dr. R. S. Lull has described seven species, with two new species and one new genus. Included in the list are a sabre-tooth tiger, deer, four-horned antelope, bison, camels, horse and mammoths. Since the closing of the pit makes it impossible that further knowledge will be gained from the locality, it seems a proper time to put on record the finding of a human skeleton associated with the Pleistocene fossils of the pit.

Section of Lagow Sand Pit

Top soil. Medium grained sandy loam, dark red to black.....2 ft.

Sandy clay, hard, tenacious. Red.....3 ft.

Fine sandy clay with light calcareous segregations and streaks. Texture of sand varies. Color yellow.

Fossils: Antelope, bison, mammoth, man .....2 ft., 10 in.

Fine to coarse clean white sand and gravel. Gravel usually under one inch. Cross-bedded. Forest beds not over 12 to 14 inches, usually 3 to 4 inches.

Fossils usually found at bottom, especially larger bones. Bones clean and usually white or cream in color. Mammoth, camel.....14 ft.

On October 26, 1920, I was notified by the owner of the pit that the workmen had uncovered bones which seemed to be human. Taking with me Dr. Robert T. Hill, I visited the pit, but found that the bones had been removed from the sand.

Referring to the above section, it is noted that only the lower part of the pit, the cross-bedded white sands, are commercially valuable. The upper layers constitute an over-burden. The over-burden is removed first. All of the workmen were agreed as to the location of the find—about five feet below the surface of the soil. There was no evidence along the wall of any disturbance or mixture of the different beds from bottom to top. Dr. Hill and I made close examination on this point. Mr. Lagow pointed out that there was no evidence of a grave having been dug, when it was suggested by a bystander that the man had been recently buried. The layers above the bones were well-marked stiff clays, and would apparently have shown any change or mixture with the beds below, such as would have been the case in digging a grave.

An examination of the sand and dirt found on the bones confirmed the statements of the pit men as to the exact position of the find. Mr. W. E. Wrather and Professor J. D. Boon, geologists, also visited the pit on the following day, likewise agreeing that there was no evidence of disturbance in the layers above the position of the human bones.

Only the one skeleton was found in the pit. No human implements or artifacts have been recovered. Dr. George Grant MacCurdy made the following report on the specimens:

> The human bones from Dallas comprise segments of right and left femur, right and left tibia and right fibula; also the left horizontal ramus of the lower jaw and several fragments of the calotte. All presumably belong to one individual, a large adult male of the modern type. This is about all one could say without having in hand more of the skeleton.

A chemical analysis of the fossilized bones from the human skull and from the camel skull made by Miss May Whidsit, of Southern Methodist University, gives the following results:

Human:

P_2O_5 .....30%

CaO 57.8%

.....32.3%

Camel:

P_2O_5 .....31.5%

CaO .....55.4 %

.....31.04%

The degree of fossilization of the human skull and that of the camel are approximately the

same. Had these human bones been of any other species, no question of association would be raised. All would agree that they were contemporaneous.

In the Lagow Sand Pit it is necessary to lay aside the association of "modern man" with Pleistocene fossils as due to burial by landslide, by recent stream action, by uprooting trees, or by any agency except a human agency. If the remains were buried by human agency, two things appear remarkable: First, that there was no visible evidence of the grave having been dug, although the skeleton was found in a sand layer beneath two beds of clay; second, that while the deposits of fossils in certain areas of the pit were much richer than others, and occupy limited areas in the pit, the location of the supposed grave was, *mirabile dictu*, placed exactly in such a limited fossiliferous area as would have occurred if laid down contemporaneously with the other fossils.

An account of this occurrence was withheld from print in the hope that further material would be found. At least a dozen occurrences in North America report human remains or artifacts associated with Pleistocene fossils or Pleistocene deposits. A review of these cases shows that in applying the theory of the multiple hypothesis, the most elaborate and involved explanation is always chosen rather than the simple direct fact of visible association and contemporaneity. Should a visible association be of less importance than a preconceived notion as to the type of man which ought to be uncovered with Pleistocene fossils?

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THE EFFECT OF SODIUM HYPOCHLORITE UPON THE SPORES OF AMERICAN FOUL BROOD (BACILLUS LARVAE)

DURING the past year we have conducted a number of experiments with various preparations of sodium hypochlorite to determine whether or not this chemical has any value in destroying the spores of *Bacillus larvæ*.

Three lines of experiments were used:

(1) To determine if diluted solutions in sugar syrup fed to the bees would have any effect on control of the disease in a working colony.

(2) To determine if combs containing dead larvæ or dry extracting combs from diseased colonies might be treated and used again without carrying the infection.

(3) To determine if infected honey might be treated so that it could be fed back to the bees without danger of carrying the infection.

(4) To determine if sodium hypochlorite might be used as a disinfectant for hives, hive parts, extractors and other equipment.

The results of these experiments show that sodium hypochlorite has a solvent action on dead bees, pollen, cocoons and other debris in the combs but that it does not injure the wax, and while certain concentrated solutions will dissolve a dead bee in a short time, diluted they are not at all harmful to the bees when added to their food.

Larvæ dead from foul brood and living in the cells as scales were completely dissolved out in twenty-four hours. Four of these combs placed in colonies of bees in June remained free of disease throughout the summer, although the bees continued to rear brood in them.

Sugar syrup to which a water solution of spores had been added failed to carry the disease when treated with a 1 to 25 dilution of a 3 per cent. solution of sodium hypochlorite.

In an experiment where three colonies of bees were fed a diluted solution of diseased honey treated with sodium hypochlorite, two of the colonies had not showed any signs of disease six weeks after feeding; the third colony developed the disease but there is evidence to show that the disease may have come from an outside source.

For disinfecting hive bodies and equipment a special solution was found to be a hundred per cent. efficient.

Experiments in feeding to counteract the disease in colonies already infected were unsuccessful.

The particular value of a special hypochlorite finally decided upon is that it destroys the spores wherever it comes in contact with them but is not poisonous and may be fed in syrup or honey to the bees without apparent injury to them.

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